THE ON-LINE BEAM CONTROL AND DIAGNOSIS SYSTEM OF TARN

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The computer system was used for data logging of accelerator parameters to understand the operation algorism at the beginning. Nowadays, once the beam succeeds in multiturn-injection into the ring, it stably continues to be injected and turned. The skill and algorism to find the optimum opration point has been established. As experiments for accelerator physics have increased in TARN, importance of usage of the computer network is going to move from beam control to beam diagnosis.

Computer Network

The TARN computer network has been developed and it now consists of two minicomputer systems (HP-1000 and PANAFACOM U400), the central computer (FACOM M180 II AD) and several microcomputers, as shown in Fig. 1. The network is constructed so that each of computer systems of three different ranks may organically perform its own full capability and may use other computer resources. Task access is designed to be able only both at the monitorscope terminal of the TARN operation console and at graphics terminal of HP-1000, after IPL of each computer.

The main interfacing with external equipments and instruments is made through CAMAC system on U400 side, except modules in PANAFACOM ICU (Interface Circuit Unit) used for the data logging of accelerator parameters. At present, the CAMAC system consists of two crates. It enables the data acquisition from any modules anywhere at the interval of time shorter than 10 m sec. Further, the installation of an auxiliary crate controller with a microprosessor (ACCM) provides much faster data acquisition time than 10 μ sec. On the other hand, HP-1000 system is connected to external devices via HP-IB line whose merit is the fact that most of RF measurement and control devices and other instruments for high precision measurement include such interfaces in commertial base.

Two kinds of graphics terminals are used as interactive input/output devices, which are main man-machine interfaces between the operator and the TARN computer network. The operator selects a task number, whose task will be executed, among the menu of registered tasks displayed on the CRT's, and enters it from the keyboard. The tast is executed under a respective task-management task at U400 and at HP-1000. Tasks on HP-1000 initiate those of U400 to make communication with them. Tasks on U400 can initiate those in M180 II AD, too. At present, task initiation from U400 is not adopted for HP-1000.

Several request keys of the operation console are assinged to initiation of particular tasks on U400 side for data logging of various parameter groups.

Microcomputers are distributed for the TARN local control systems in order that each one performs a single allocated task to reduce a heavy load on minicomputers. They are single board type microcomputers without software development tool. The load modules are developed with U400. Their down-line-loading and initiation are carried out by individual tasks of minicomputers.

Beam Control and Diagnosis

The TARN computer network is used for various purposes. At first, it was used mainly for voltage pattern generation of RF and data logging of accelerator parameters. However, as the study of accelerator physics proceeds at TARN, more quantitative data are needed and fast data acquisition is required, which necessarily leads to utilization of a computer. Now almost all beam diagnoses are made with the use of the computer network.

Recently, a CAMAC gate function generator was developed with a 10 Mhz clock. It provides a series of trigger or gate signal for an input external trigger signal. Timing signal is designed as what we want by cascade-connection of these modules. Due to addition of this function to the existing manual timing controller, it becomes easy to change injection times, RF stacking times, interval time between injections. It becomes possible to supply fine synchronous tigger or gate signals for data acquisition of beam diagnosis, too.

The apparatus for the emittance measurement is located about 10 m upstream from the injection position of the TARN. There are eight elements (four quadrupole magnets, two bending ones, and two electrostatic inflectors) between the monitor and the injection position. Results of the emittance measurement and logged data of the elements are transferred from U400 to the central computer M180 II AD, where the desirable parameters of elements are searched. Obtained results are sent back to HP-1000 through U400. The elements are tuned with aid of the central computer.

TARN has eight straight sections named S1 to S8 along the beam stream from the beam injection section. For the first tuning of the injection orbit, single rod monitors at S1, S3 and S6 are used under CPU control, as well as multi-wire profile monitors of manual operation at S2 and S8. They are used for observation of the radial position of the single turn beam and the four-turn beam when Q-value is tuned to be 2.25. Next in order to tune the parameters on the multiturn injection, the signal of the electrostatic beam monitor at S3 and S6 are referred to on the oscilloscope. The survival of the beam for long time over one second is confirmed by the measurement using the scintillation monitor at S7.

The RF stacking into the longitudinal phase space is performed by a repetitive stacking method. The function generation of RF voltage and frequency sweep is carried out by HP-1000 and TK-80 CPU network. The operator can provide a set of the programmed functions of defferent parameters with HP-1000. Shacking hands with HP-1000 for data handling, TK-80 supplies the programmed function through DAC to the RF system synchronously with the trigger signal from CAMAC gate function generator.

The RF stacking experiment is carried out to analyse the dependence on the RF voltage and sweep functions, and the capture frequency in pursuit of the high stacking efficiency. A scintillation monitor is used to measure the radial beam profile. A permalloy monitor with long time constant ($\sim$1 sec) is used to measure beam intensity during the stacking process.

As the preparatory work for the construction of a stochastic cooling system at TARN, obsrevation of Schottky signal is performed. Due to the developement of a beam diagnostic system with a spectrum analyser linked to the computer network, it has become possible to measure the Q-value without disturbing the beam in TARN.[1)]

Reference

1) A. Noda et al., contributed to the symposium.

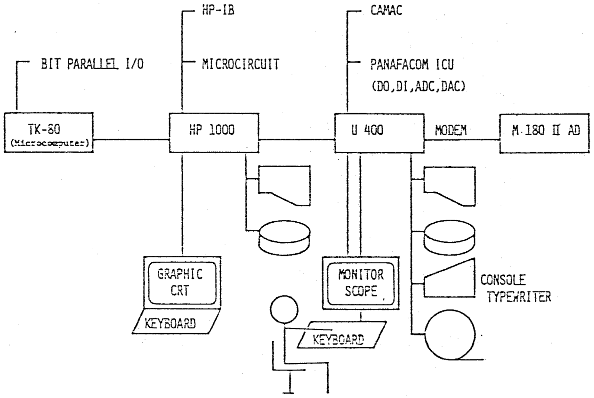

Fig. 1 TARN computer network